QNET

Six Sigma Training:

Green Belt Certification Course

A 5 day course and Green Belt Project – February to May, 2005

Who should attend?

You should be familiar with the concepts of Six Sigma and are interested in becoming a certified Green Belt, or ultimately a Black Belt.

Each participant must have a workplace champion/sponsor, an executive accountable for the green belt project completed by the participant.

Note: The Green Belt projects should be selected and scoped to deliver a net return on an organization's Six Sigma Green Belt training investment (approximately $50,000 to $75,000 quantified return), and should be manageable and doable in 3-4 months.

Objectives of Green Belt Certification:

- To develop functioning Green Belts capable of solving process issues.
- To demonstrate a return for participating organizations on the Green Belt investment.
- To provide an economical local approach for organizations to develop Certified Green Belts.

Objectives of the Green Belt Course:

- To learn the fundamental concepts of Six Sigma;
- To learn the fundamental Six Sigma improvement methodology;
- To learn fundamental building-block tools;
- To develop critical thinking;
- To develop facilitation, coaching, and presentation skills;
- To develop data analysis skills using Minitab;
- To get "real" results by applying Green Belt skills to a strategic project.

Training Schedule:

What	When	Who	Objective
½ Day Green Belt and Champion preparation meeting	Monday, February 14, 2005 Morning (exact time TBA)	Green Belt Training Participants and their Champions/sponsors	To clarify the role of the Green Belt Project Sponsor and Champion To draft a Green Belt Project Charter
Green Belt Classroom training	5 days (8:15 a.m. to 4:30 p.m.): • Monday, February 21, 2005 • Monday, March 7, 2005 • Monday, March 21, 2005 • Monday, April 11, 2005 • Monday, April 25, 2005	Green Belt candidates	To develop Green Belt competency
Green Belt Project	4 Months – February to May, 2005	Green Belt candidates and project team	To successfully complete a Green Belt level project
Champion Support	½ day upon completion of Green Belt class training	Project Champions/sponsors	To prepare Champions to successfully fulfill their Six Sigma role
Green Belt Graduation & project sharing forum	May/June, 2005	Green Belt candidates and Champions	To celebrate/recognize the Green Belt accomplishments

- -

REGISTRATION FORM: Please fax to QNET (204) 949-4990 or register online at www.qnet.mb.ca

Name_____

Position_____

Organization_____

Address_____

City_____ Post Code_____

Ph_____ Fax_____

Email_____

Project Champion_____

FEE: $3,000.00 + gst ($210.00) - G.S.T. Reg # 899755334RT

PAYMENT: ? Please Invoice ? VISA ? AMEX ? MasterCard

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EVENT LOCATION: Lynmart Training Room, Suite 546 (5th floor), 167 Lombard Avenue (Grain Exchange Building).
CANCELLATIONS: must be received in writing by Feb 7/05. After that, the full registration fee will apply.

Over for more details...

Green Belt Certification Course, continued...

Cost for Green Belt Certification:

- The course fee of $3,000 + gst includes:
  - Course materials
  - Textbook: What is Six Sigma by Pande
  - Textbook: Flawless Consulting by Block
  - Textbook: Making Sense of Data by Wheeler

- Project/Leadership Consulting Support – extra at $3,000.00 CDN per day $1,500.00 CDN per ½ day to be invoiced directly to the client organization as incurred.
  - Recommended ½ day per month support through to project completion to support each Green Belt Project.

- Note: The projects should be selected and scoped to deliver a minimum $50,000 to $75,000 quantified return.

Keys to Six Sigma Success:

- Committed Executives
- Clearly defined Six Sigma Goals and Roles
- High Quality Green/Black Belt candidate selection
- Well scoped, strategic projects
- Disciplined application of Six Sigma methods.

- A results-oriented focus.
- Credible, knowledgeable Six Sigma consulting guide.

The Green Belt course has some Minitab Exercises built in. It is recommended, but optional, that participants have portable computers with Minitab loaded (a free 30 day trial download is available – www.minitab.com).

Criteria for Green Belt Certification:

- Successful completion of training and Green Belt examination;
- Successful completion of project demonstrating Green Belt level competence

Overview of Long Term Plan toward Black Belt Certification:

- Step 1: Green Belt Certification Requirements:
  - 5 days classroom training and Green Belt examination.
  - Complete 1 project to the satisfaction of the Six Sigma Consultant and the project Champion.

- Step 2: Green Belt Plus Certification (about 6 months later):
  - Prerequisite: Green Belt Certified
  - 5 days classroom training and Green Belt Plus examination.
  - Complete 1 project to the satisfaction of the Six Sigma Consultant and the project Champion

- Step 3: Black Belt Certification (about 6 months later):
  - Prerequisite: Green Belt Plus Certified
  - 10 days classroom training and Black Belt examination.
  - Complete 1 project to the satisfaction of the Six Sigma Consultant and the project Champion.

Six Sigma Consultant – Vern Campbell:

Vern Campbell is General Manager of CML Northern Blower and is also an Affiliate Consultant with Bluefire Partners. Bluefire Partners is a leading management consulting firm that specializes in assisting clients to implement Six Sigma within the framework of an integrated Enterprise Improvement System.

Northern Blower is currently working to integrate Six Sigma methods, the Toyota production System, ISO 9000:2000 and Strategy Management into an overall Enterprise Improvement System. Previously, Vern was the Quality Coordinator at Manitoba Hydro with responsibility for implementing Manitoba Hydro's Quality Improvement Initiative.

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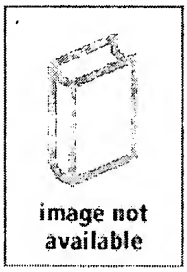

Six Sigma Deployment
By (author) Adams, Cary By (author) Gupta, Praveen By (author) Wilson, Charlie

Bookseller:
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(United Kingdom, ., United Kingdom)

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About the Book | **Bookseller & Payment Information**

Description: Book Condition: BRAND NEW HARDBACK. 9.25 by 6.06 inches. (290 pages : Six Sigma Deployment provides a thorough understanding of the Six Sigma methodologies and its implementation in various industries. The authors offer practical information for successful implementation as well as what is needed to plan, monitor and steer this business strategy toward success.Some of the unique aspects of this book include the use of Six Sigma with the various quality standards that are being implemented today, the implementation of Six Sigma in supply chain management stream, and the analysis of different methods used by various companies, the strengths and weaknesses of each, results achieved and finally lessons learned. In addition, an appendix is provided that includes the various statistical or non-statistical tools employed during the implementation of Six Sigma.Who Needs It?; What Is Six Sigma?; Six Sigma Deployment Overview; Opportunity; Management and Champions; Strategic Plan; Project Selection; Coaching; Black Belts; Green Belt; Awareness; Six Sigma Success Stories; Enhancing Six Sigma to Deliver Highest Performance at Lowest Cost; Six Sigma Methodology - The Benefits of a Strategic Approach; Six Sigma and Quality Systems; Final Thoughts; History of Six Sigma; Tools Commonly Used in Six Sigma; Training Certifications; Brief Overview of Black Belt Projects"provides a thorough understanding of the Six Sigma methodologies and its implementation in various industries. The authors offer practical information for successful implementation as well as what is needed to plan, monitor and steer this business strategy toward success."Quality Today, April 2003 BiographicalNote: Mr. Wilson is a Consultant Partner of Adams Associates and President of LakotaTraining & Development. He is degreed in Psychology, Behavioral Sciences andMBA. He holds Master Trainer Certifications in Quality and StatisticalImprovement Processes, Behavior Intervention and Coaching, Employee Development,Team Building, Leadership, Organizational Training Development, ProjectManagement, Environmental Health and Safety, Facilitation and PresentationSkills.Mr. Wilson is a management consultant with over 30 years experience inoperations, training, industrial

Bibliographic Details

ISBN: 0750675233
Publisher: Elsevier Science & Technology
Publication Date: 2003
Binding: Hardback

and quality. During the last decade he has assisted power,pipeline distribution, chemical, manufacturing, maintenance, computer componentmanufacturing, health care and distribution industries to develop and implementsuccessful business improvement strategies. He has developed hundreds oftraining programs, published articles for periodicals and produced over 30safety training videos. Charlie's speaking engagements have included theNational Safety Council, Texas Safety Association, Associated Builders &Contractors, Contractors Safety Council, National Metals Trades Council, as wellas numerous client businesses, schools, non-profit organizations andparticipation on the Texas Governors Quality Forum. Mr. Wilson collaborated onthe development of a full line of modular formatted classroom and distancelearning Six Sigma Plus training programs. Six Sigma Plus includes Management,Champion, Black Belt, Green Belt, Awareness, Project Demonstration andAggressive Implementation. AudienceDescription: Industrial Engineers, Industrial Production Managers, Students in undergraduate or gradate programs in Industrial Engineering or Management. Bookseller Inventory # AD0750675233

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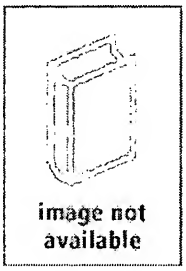

Six Sigma for the Office: A Pocket Guide
Roderick A. Munro

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(Berkshire, ., United Kingdom)

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Description: The principles of Six Sigma are being used in nearly every industry to reduce waste and improve performance. However, most books on the subject are written only for those in manufacturing, and specifically for engineers or those with a high level of technical expertise. Meanwhile, those working in offices receive little or no information on how to use Six Sigma in their environments. Now best-selling author Rod Munro has written a convenient book explaining the tools of Six Sigma, specifically tailored to those in the office. Six Sigma for the Office: A Pocket Guide is a convenient guide for anyone working on Six Sigma projects in non-manufacturing environments. Specifically written for those at the green belt level, this book will help explain the Six Sigma tools and show how they apply to those working in an office. All the examples in the book are taken from the office environment, so office workers will easily identify, and be able to apply these tools in their own jobs. Bookseller Inventory # ASQ 074

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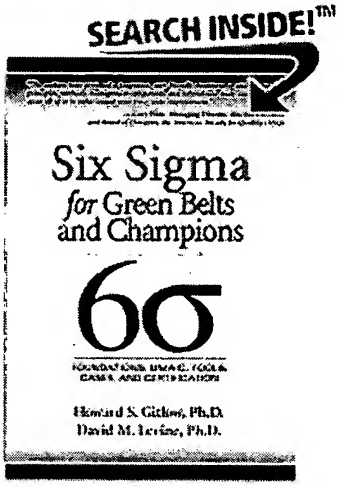

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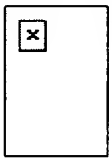


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"Much has been said or written in recent times about the value of Six Sigma methodologies in c organizational improvement. Yet, so many still seem to be intimidated by or skeptical about the principles and tools. In this text, Drs. Gitlow and Levine have provided a pragmatic, user-friend treatment of underlying principles and methods, management obligations, and helpful case stuc examples to assist all of us in value-added enterprise-wide improvement."

—Gary Floss, Managing Director, Bluefire Partners, and Board of Directors, the American Societ Quality (ASQ)

"The authors provide the perfect blend of managerial insight and a straightforward "how to" apj statistics. Anyone interested in learning about Six Sigma for the first time, or practitioners wanl learn more, will find this book to-the-point, exciting, and easy to read. And also hard to put dov

—Timothy C. Krehbiel, Professor of Decision Sciences and MIS, Miami University (Ohio)

"This book provides an excellent understanding of the foundations of quality management that basis for the evolution of Six Sigma. For executives who wish to be "Champions" of Six Sigma, provides an understanding of what to expect of Green Belts as they work through a DMAIC proj what they should expect of themselves. Green Belt candidates will find the case studies extrem and informative. Both Champions and Green Belts will benefit from the comprehensive coverag certification."

—Edward A. Popovich, Ph. D., Vice President, Enterprise Excellence, Boca Raton Community Ho
President, Sterling Enterprises International, Inc.

The first complete Six Sigma implementation guide for Green Belts and Champions!

1. Understand the rationale for Six Sigma
2. Implement a proven executive framework for a successful quality initiative
3. Use the DMAIC method for improvement from start to finish: Define, Measure, Analyze, I
and Control
4. Manage Six Sigma statistics—without becoming a statistician
5. Learn through complete detailed manufacturing and service case studies
6. Learn how to understand and manage Six Sigma statistics, through practical, Minitab-bas
application examples. Includes instructions for using Minitab software
7. Learn how to pass Six Sigma certification examinations with sample questions and answe

If you're "project managing" Six Sigma (potential Green Belt)—or promoting it at the executive
(potential Champion)—this is your book. It's the first Six Sigma book written specifically for Gre
Champions...and anyone who plans to become one. Two experts help you master the entire DM
model: Define, Measure, Analyze, Improve, and Control. You'll discover realistic solutions for Si
profound human and technical challenges. You can even prepare for one of the world's leading
certification programs. Clear, detailed, and proven...this is the one indispensable book for anyo
must manage Six Sigma to success.

About the Author

David M. Levine is Professor Emeritus of Statistics and Computer Information Systems at Berr
Baruch College (City University of New York). He received B.B.A. and M.B.A. degrees in Statisti
City College of New York and a Ph.D. degree from New York University in Industrial Engineering
Operations Research. He is nationally recognized as a leading innovator in business statistics ec
and is the co-author of such best-selling statistics textbooks as *Statistics for Managers using Mi
Excel, Basic Business Statistics: Concepts and Applications, Business Statistics: A First Course,
Applied Statistics for Engineers and Scientists using Microsoft Excel and Minitab*, He has publish
in various journals including *Psychometrika*, *The American Statistician*, *Communications in Stat
Multivariate Behavioral Research*, *Journal of Systems Management*, *Quality Progress*, and *The A
Anthropologist*.

Dr. Howard S. Gitlow is Executive Director of the University of Miami Institute for the Study o
in Manufacturing and Service and a Professor of Management Science, University of Miami, Cora
Florida. He was a Visiting Professor at the Science University of Tokyo in 1990 where he studiec
Management with Dr. Noriaki Kano. He received his Ph.D. in Statistics (1974), M.B.A. (1972), a
Statistics (1969) from New York University. His areas of specialization are Six Sigma Manageme
Deming's theory of management, Japanese Total Quality Control, and statistical quality control.

Dr. Gitlow is a Six Sigma Master Black Belt, a senior member of the American Society for Qualit
and a member of the American Statistical Association. He has consulted on quality, productivity
related matters with many organizations, including several Fortune 500 companies.

Dr. Gitlow has co-authored several books. These include: *Quality Management: Tools and Meth
Improvement*, Richard D. Irwin Publishers (2005), third edition; *Quality Management Systems*,

(2000), *Total Quality Management in Action*, Prentice-Hall, (1994); *The Deming Guide to Qualit Competitive Position*, Prentice-Hall, (1987), fifteenth printing; *Planning for Quality, Productivity Competitive Position*, Dow Jones-Irwin Publishers (1990); and *Stat City: Understanding Statisti Realistic Applications*, Richard D. Irwin Publishers (1987), second edition. He has published ove academic articles in the areas of quality, statistics, management, and marketing.

While at the University of Miami, Dr. Gitlow has received awards for Outstanding Teaching, Out: Writing, and Outstanding Published Research Articles.

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Product Details

Hardcover: 736 pages

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Product Dimensions: 9.5 x 7.4 x 1.3 inches

Shipping Weight: 2.7 pounds. (View shipping rates and policies)

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101 Things A Green Belt Should Know

By Zack Swinney

You caught me. There aren't 101 things a Six Sigma Green Belt should know listed below. But the beauty of the iSixSigma community is that everyone is always willing to share thoughts and experiences. Collectively, we can come up with 101 things. Let me know what you think:

- What other "pearls of wisdom" should be sharing with potential Six Sigma Green Belts?
- What requirements are there of Green Belts at your organization that you think should be ubiquitous within the profession?

Send your bulletized thoughts to me through iSixSigma at GreenBelt101@iSixSigma.com. I promise to review every response and if there is enough agreement, your idea will be added to the list. Let's make a list of 101 soon!

1. Green Belts lead Six Sigma improvement projects part time. Usually 25-50% of their time is spent on Six Sigma projects.
2. Six Sigma will become a "way of doing business" for Green Belts.
3. Green Belts will be able to explain why the y=f(x) formula is important for their process and business.
4. Becoming a Green Belt is an opportunity to gain valuable tools and experience.
5. Green Belts who display prowess of Six Sigma methods and produce significant benefits are usually promoted within organizations.
6. Unlike Black Belts who typically lead cross-functional projects, Six Sigma Green B projects within their own functional area.
7. Green Belts receive less instruction on Six Sigma methods, tools and techniques t usually receive between three and 10 days, whereas Black Belts receive upwards
8. Six Sigma Green Belts are selected by the organization's management team.
9. Six Sigma Green Belts will be able to explain the Kano diagram and how it relates
10. Some organizations require all exempt employees to be "certified" Green Belts be require employees to at least undergo training.
11. Green Belts can be trained in classroom sessions, completely online, or a combin
12. The Six Sigma Green Belt training curriculum varies from company to company.

13. Green Belt performance is usually evaluated in the employee's regular performanc some companies may provide additional incentives for completing a project or bec
14. Six Sigma Green Belt certification requirements vary from company to company. T include: completion of training, passing a written or online test, and completion of
15. Certification as a Green Belt from one company most likely will not be recognized
16. Some companies require Green Belts to complete one project per year to maintair requirements.
17. Green Belts are usually instructed on the Six Sigma DMAIC methodology and a lir basic statistics. More advanced statistics usually require support from a Black Belt
18. Six Sigma Green Belts should expect to schedule regularly occurring meetings wit review project progress and seek advice.
19. Project tollgate reviews usually take place with the organization's management tea not, at some point you'll either get kudos or a kick in the bottom for your project's p
20. Green Belts will be able to create a histogram and pareto diagram, and know the c two.
21. Adding Green Belt training and a project adds to what must be accomplished in th remember: productivity and benefits you gain from your project will make your life you rather put out fires everyday or start preventing fires from occurring?
22. Not everyone on your Green Belt team is going to like the Six Sigma improvement difficult for people to embrace. Your leadership will play a critical role in shaping th outcomes.
23. Putting off your Six Sigma Green Belt project until tomorrow will leave you a lot of day before your tollgate review. Just because your project needs resuscitation anc automatically make it a priority for your Black Belt. Plan ahead and stay in control
24. Managing by data is always defensible. "Gut instinct" will not be valued in the busi Belt projects help employees "see the light."
25. If you haven't dealt with finances much in the past, your Green Belt project is an o equations, quantify project benefits, and speak the language of management.
26. The Six Sigma Green Belt shouldn't necessarily know how to use every tool availa however, know of the existence of tools and be able to ask Black Belts for help.
27. Six Sigma Green Belts will lead the data collection process of their project and val system.
28. The Green Belt should expect to work on and improve their team facilitation skills.
29. The Six Sigma Green Belt will be able to calculate the mean and standard deviatic sets.
30. The Six Sigma Green Belt will be able to calculate short term and long term Sigma process.
31. Green Belts are selected because they are business professionals, not Quality gu
32. Green Belts will know how to perform basic statistical tests using a statistical softw or JMP.

33. Green Belts will be able to develop a charter and SIPOC for their project.
34. Six Sigma Green Belts will understand how to create a Cause And Effect (Fishbor possible causes of process defects.
35. Green Belts will be able to lead brainstorming sessions with their project team.
36. Green Belts can make their bosses and co-workers look good by using graphs to s improvement in a highly visible and easily understood visual form.
37. Green Belts can help win support for Six Sigma by preventing the defects that cre for their bosses and co-workers.
38. Green Belts can help overcome resistance to change by involving their co-workers leading them to data-driven solutions.
39. Green Belts should only start a project if there is top management sponsorship wil resources.
40. Green Belts should have a solid communication plan that is reviewed at each mee right information about the project goes up, down and out to all stakeholders.

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Home

Welcome to the Cambridge Green Belt Project and City Greenways Project. We are a long established Project working with local communities in Cambridge and the surrounding area to conserve and enhance some of the areas most important wildlife habitats. The Projects aim to:

- bring all County Wildlife Sites and three Sites of Scientific Interest (SSSI) in Green Belt area under favourable management
- encourage local communities to manage parish biodiversity sites favourably
- promote sites of wildlife interest across the Green Belt area and access to these
- increase public awareness of wildlife in the Green Belt area
- encourage and involve local people in volunteer projects

We work with local communities by offering habitat management advice, funding advice and most importantly a chance to participate in habitat management and learn new practical skills through our Mid-week volunteer teams. Volunteers are essential to the work we do and help us to put our ideas

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Build a hedgehog box!

Fireworks night is a difficult time for hedgehogs and it is unfortunate that the unwary hedgehog can be caught hibernating in our bonfire piles. See the events page to find out how you can help and build your very own hedgehog home!

Hedgelaying

Ever wanted to lean the traditional art of hedgelaying? Now is your chance. See the events page for more details.

Wildlife Reporting!

Now you can let us know about the wildlife that you have see out and about in the project area. See our sightings page for further details of wildlife reporting, and how you can help us build our database of wildlife records.

into action.

The Cambridge Green Belt Project works in the designated Green Belt, which extends to approximately a six-mile radius from the City. Click here to see a map of the Project area. The Cambridge Green Belt Project is a partnership between Cambridgeshire County Council, South Cambridgeshire District Council, Cambridge City Council and The Wildlife Trust for Cambridgeshire. The City Greenways Project works within Cambridge and is funded by Cambridge City Council.

If you think the Cambridge Green Belt and City Greenways Project can help you then please do not hesitate to contact us!

Using the Design for Six Sigma (DFSS) Approach to Design, Test, and Evaluate to Reduce Program Risk

Dr. Mark J. Kiemele
Air Academy Associates

NDIA Test and Evaluation Summit
Victoria, British Columbia
February 24-27, 2003

Air
Academy
Associates

Agenda

- A Brief Six Sigma Primer
- The What and Why of Design for Six Sigma (DFSS)
- The DFSS Process

Six Sigma Defined

Originally: Metric Based on the Statistical Measure Called Standard Deviation

Expanded To:

WORLD CLASS QUALITY

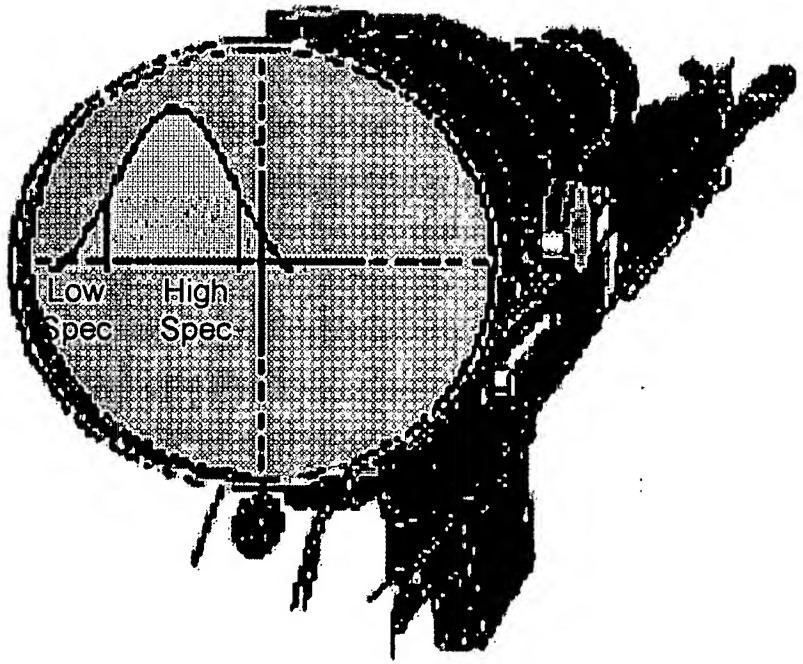
Providing a

BETTER product or service,

FASTER, and

at a LOWER COST

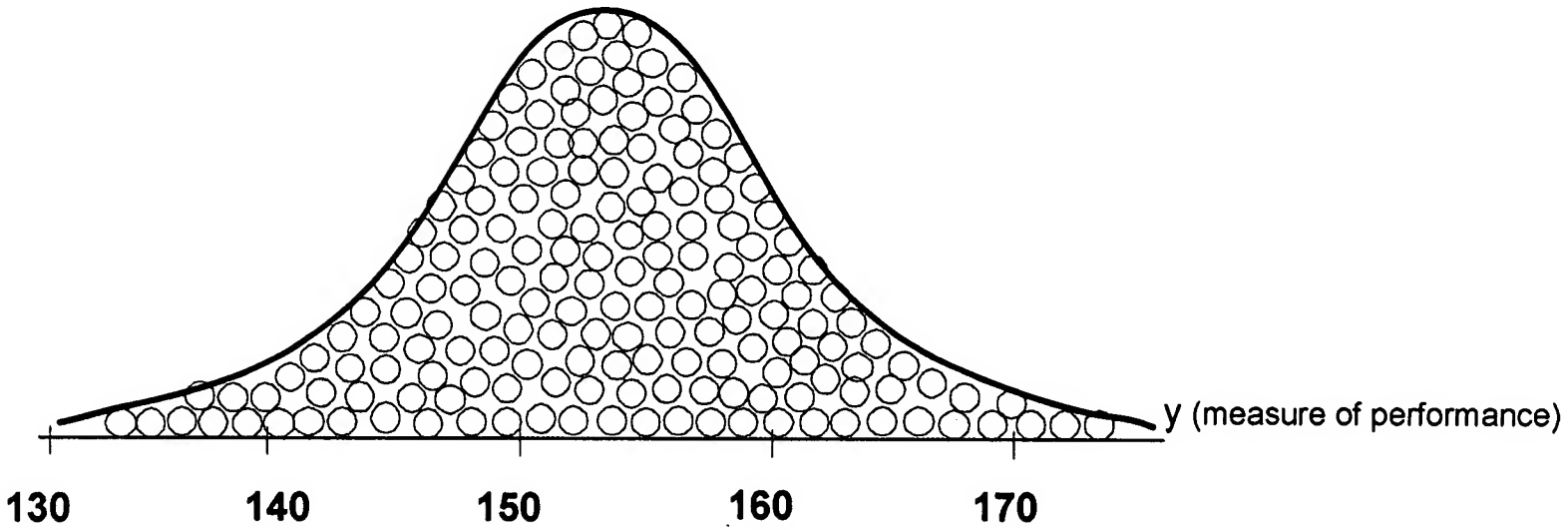
than our competition.



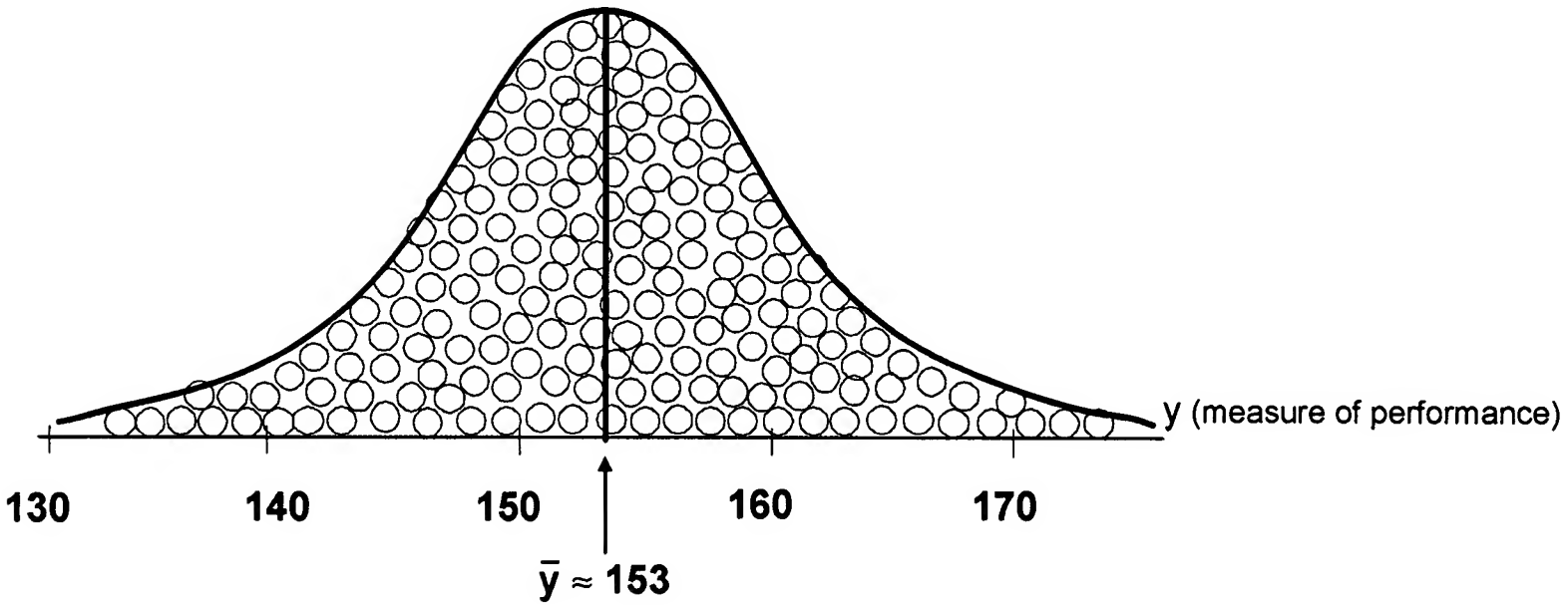
VARIATION is the enemy!

"Always know the language of the enemy."

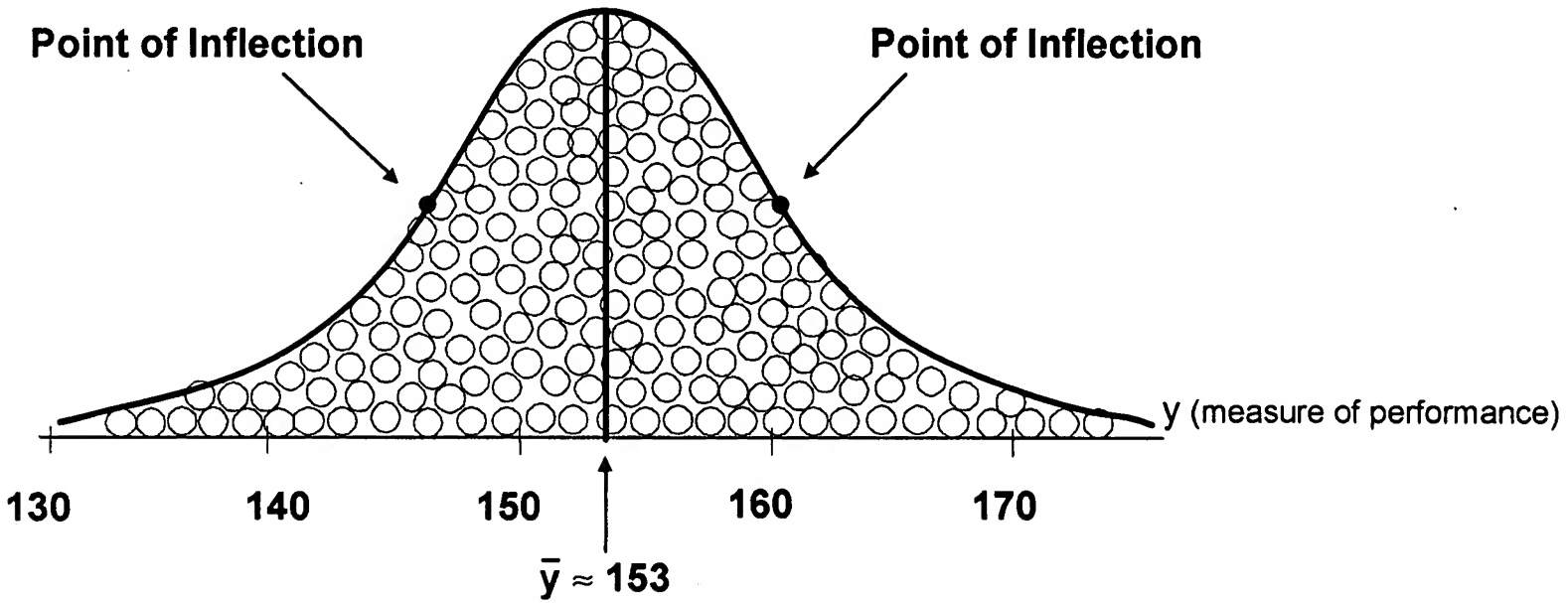
Graphical Meaning of a Distribution



Graphical Meaning of $\bar{y}$

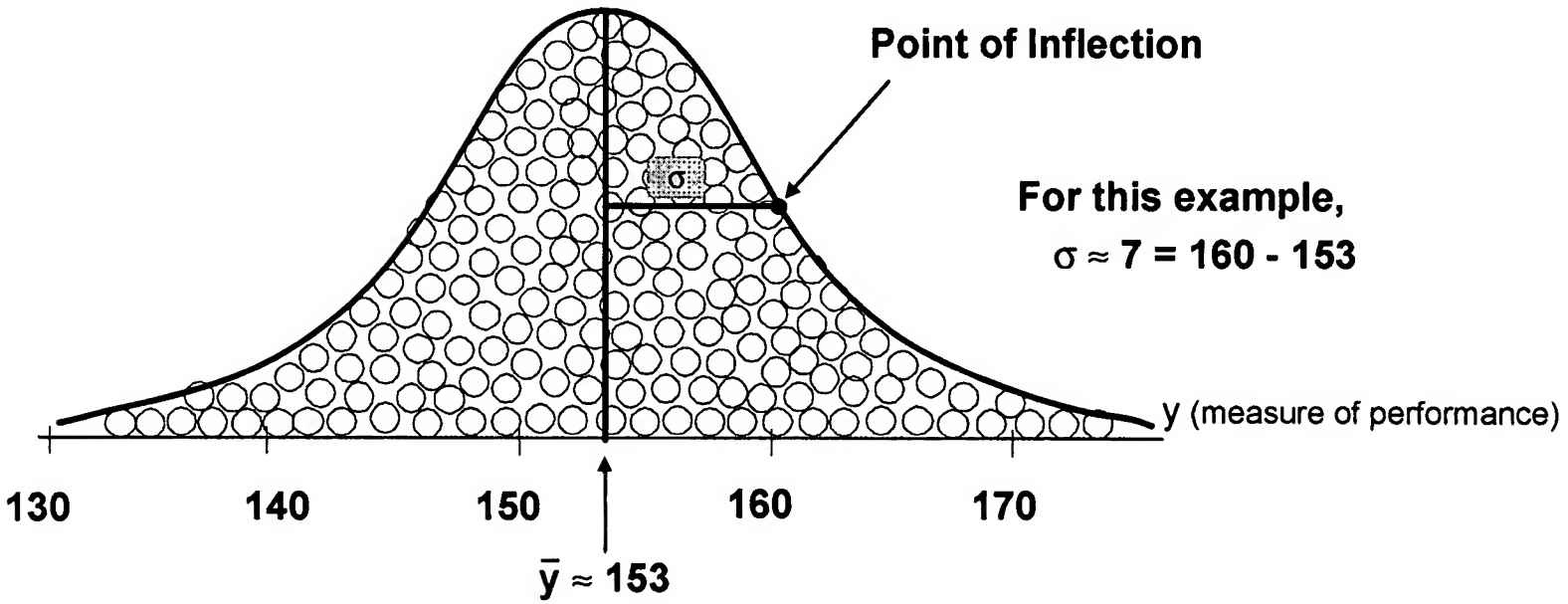


Graphical Meaning of Points of Inflection

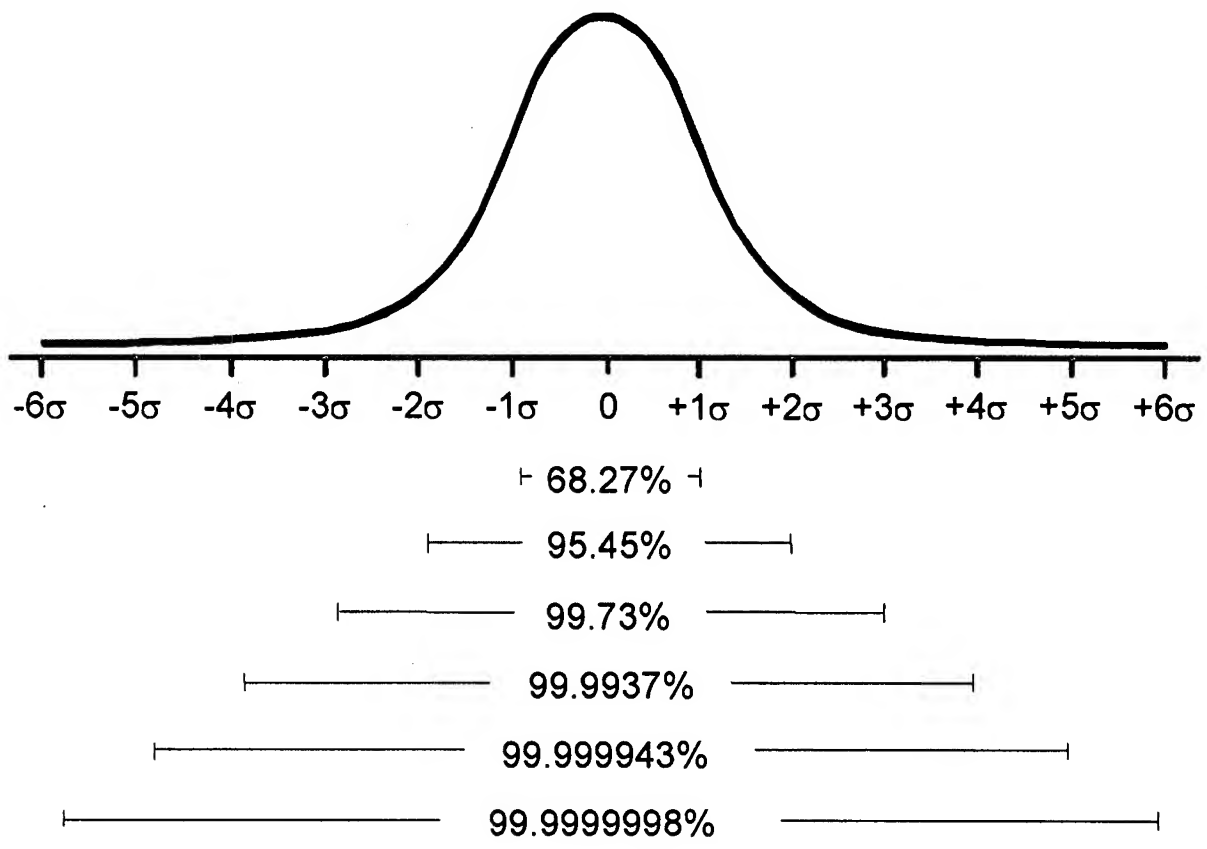


Graphical Meaning of σ

σ = distance from the center of the distribution to a point of inflection



Graphical View of Variation

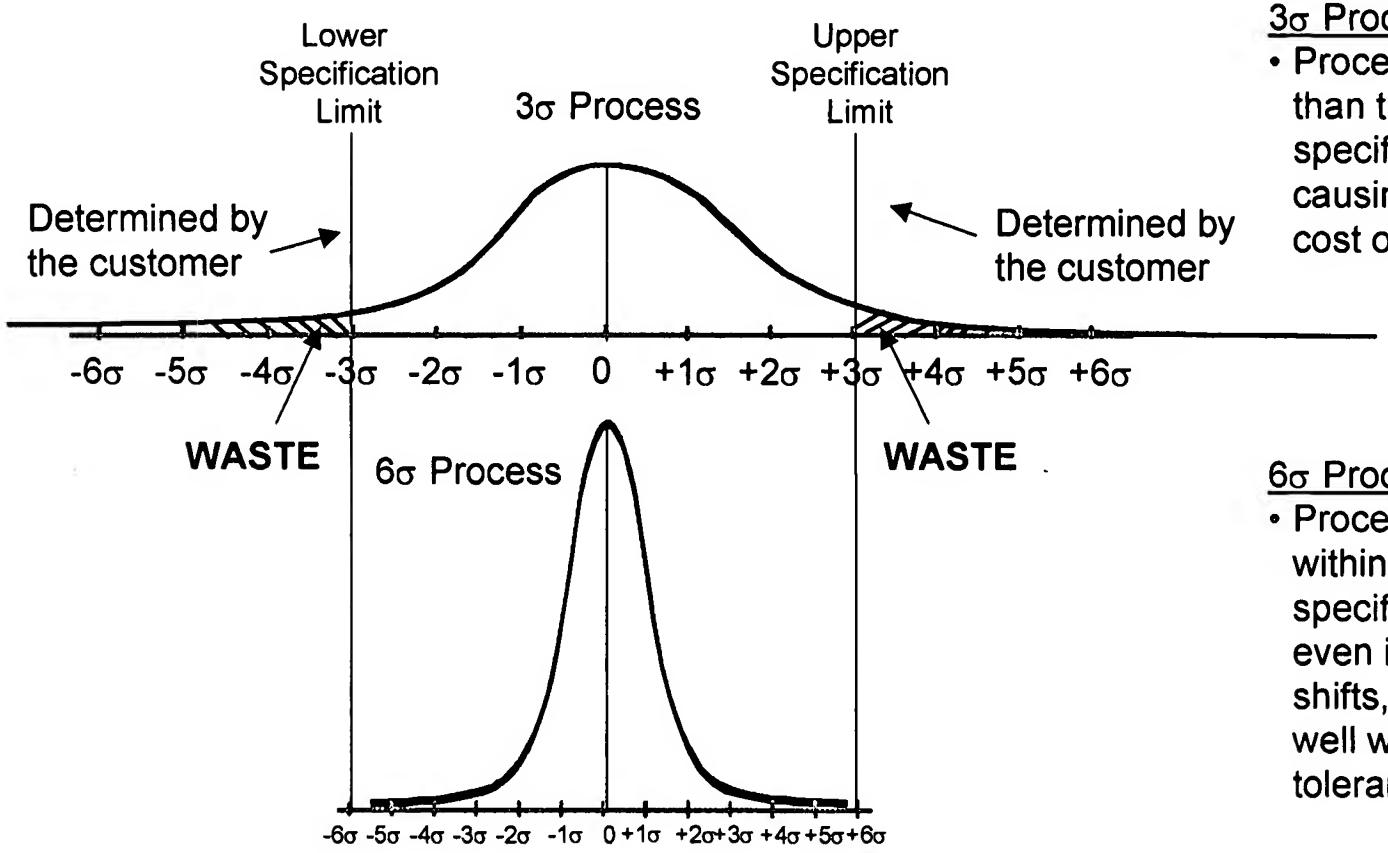


Typical Areas under the Normal Curve

Graphical View of Variation and Six Sigma Performance

The Sigma Capability of a process performance measure compares the Voice of the Process with the Voice of the Customer, and it is defined as follows:

The number of Sigmas between the center of a process performance measure distribution and the nearest specification limit



3σ Process Centered

- Process is WIDER than the specifications, causing waste and cost of poor quality

6σ Process Centered

- Process FITS well within the specifications, so even if the process shifts, the values fall well within tolerances

Six Sigma Measures Process Capability

Sigma Capability is a measure of process capability. It is correlated to the defect rate and the complexity of the process/product.

Yield is the probability that whatever we are producing (manufactured part, PO, shipped part, etc.) will pass through the entire process without rework and without defects.

σ Capability	DPMO	RTY
•	308,537	69.1%
•	66,807	93.3%
•	6,210	99.4%
•	233	99.97%
•	3.4	99.99966%

Process Capability	Defects per Million Opportunities	Rolled Throughput Yield

Six Sigma is a standard of Excellence.
It means less than 4 Defects per Million Opportunities.

Relationship Between Lean and Six Sigma

OVERALL YIELD vs SIGMA
(Distribution Shifted ±1.5σ)

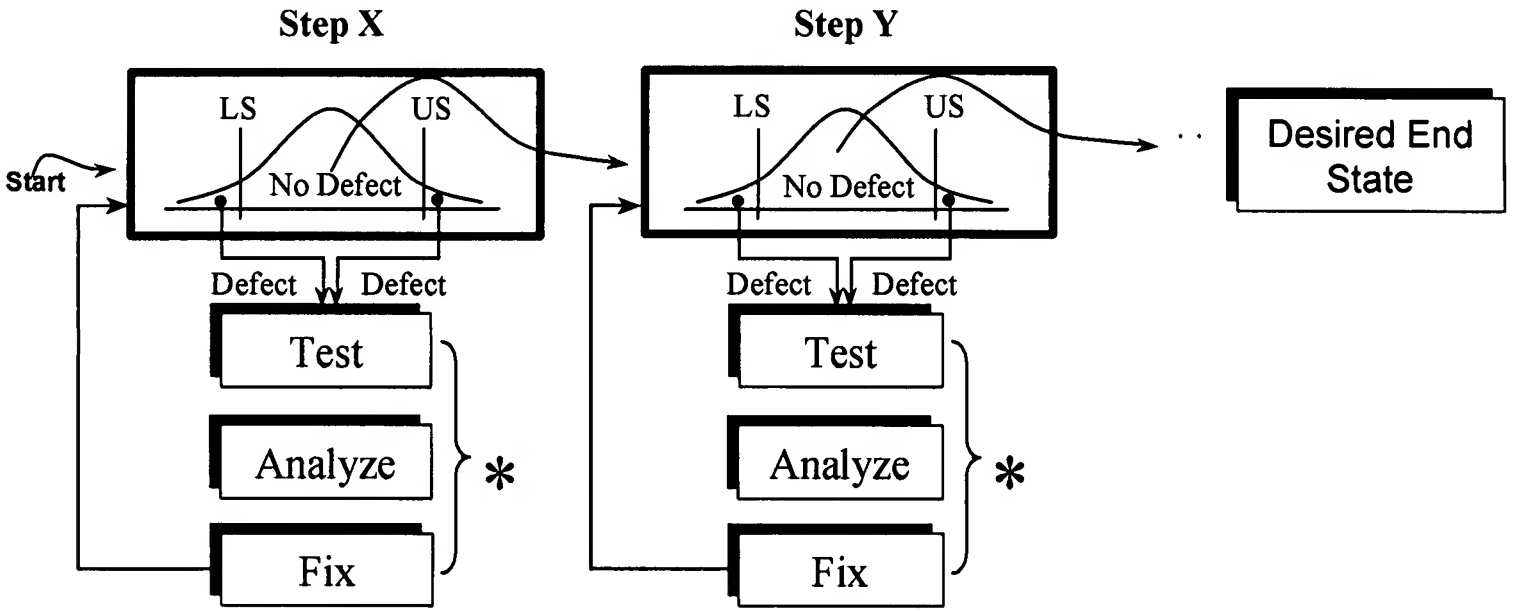
# of Parts (Steps)	±3σ	±4σ	±5σ	±6σ
1	93.32%	99.379%	99.9767%	99.99966%
7	61.63	95.733	99.839	99.9976
10	50.08	93.96	99.768	99.9966
20	25.08	88.29	99.536	99.9932
40	6.29	77.94	99.074	99.9864
60	1.58	68.81	98.614	99.9796
80	0.40	60.75	98.156	99.9728
100	0.10	53.64	97.70	99.966
150	- - -	39.38	96.61	99.949
200	- - -	28.77	95.45	99.932
300	- - -	15.43	93.26	99.898
400	- - -	8.28	91.11	99.864
500	- - -	4.44	89.02	99.830
600	- - -	2.38	86.97	99.796
700	- - -	1.28	84.97	99.762
800	- - -	0.69	83.02	99.729
900	- - -	0.37	81.11	99.695
1000	- - -	0.20	79.24	99.661
1200	- - -	0.06	75.88	99.593
3000	- - -	- - -	50.15	98.985
17000	- - -	- - -	1.91	94.384
38000	- - -	- - -	0.01	87.880
70000				78.820
150000				60.000

Use for Benchmarking

Source: Six Sigma RESEARCH INSTITUTE Motorola University Motorola, Inc.

Air Academy Associates

How Process Capability Impacts Cycle Time and Resource Allocation



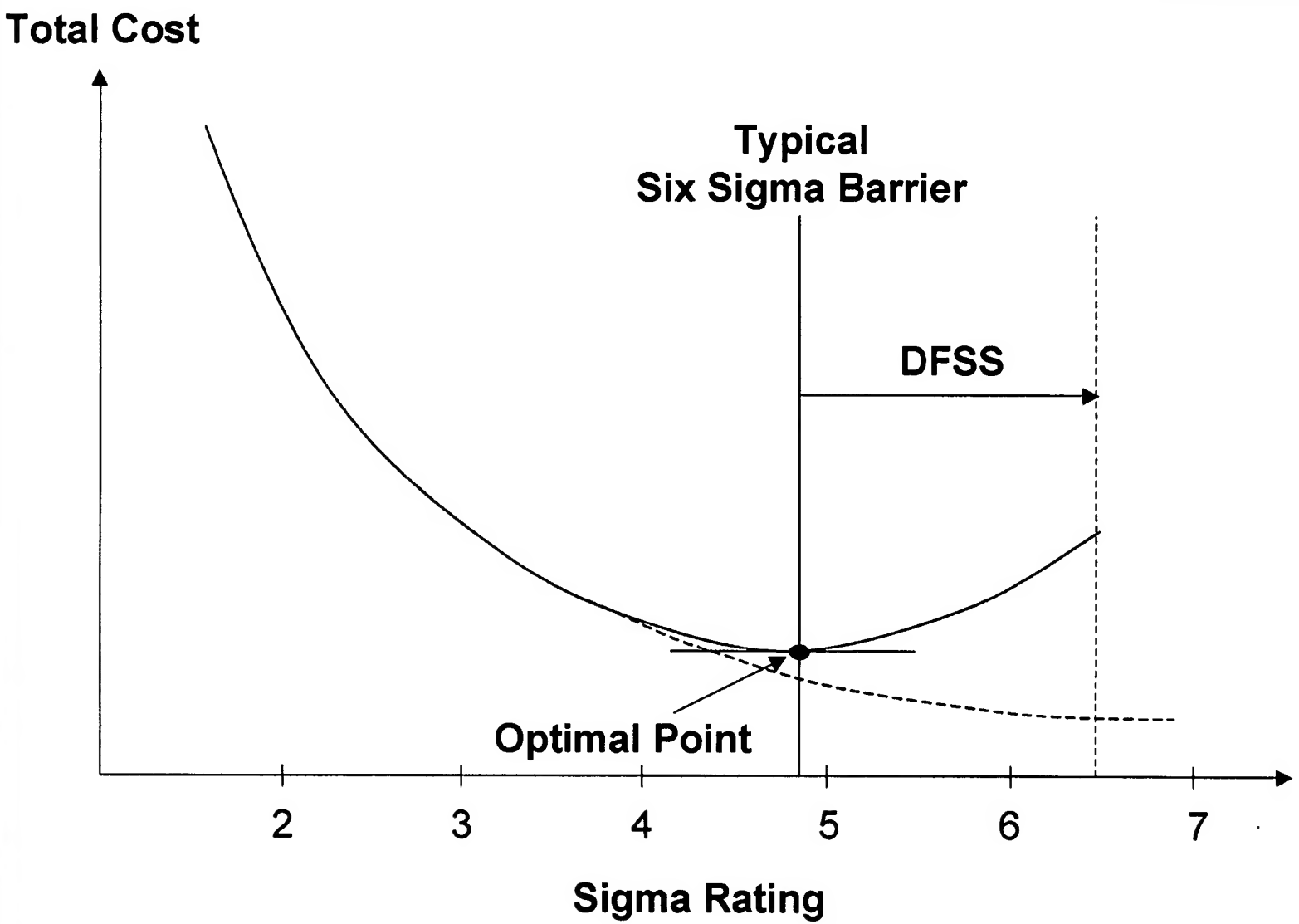
Every Time a Defect is Created During a Process (Step), it Takes Additional Cycle Time to Test, Analyze, and Fix.

* These Non-Value Added Activities Typically Require Additional Floor Space, Capital Equipment, Material, and People.

Six Sigma Project Phases

- **D** efine the problem / defects
- **M** easure the current performance level
- **A** nalyze to determine the root causes of the problem / defects
- **I** mprove by identifying and implementing solutions that eliminate root causes
- **C** ontrol by monitoring the performance of the improved process

What Have We Learned From Six Sigma?



Food for Thought...

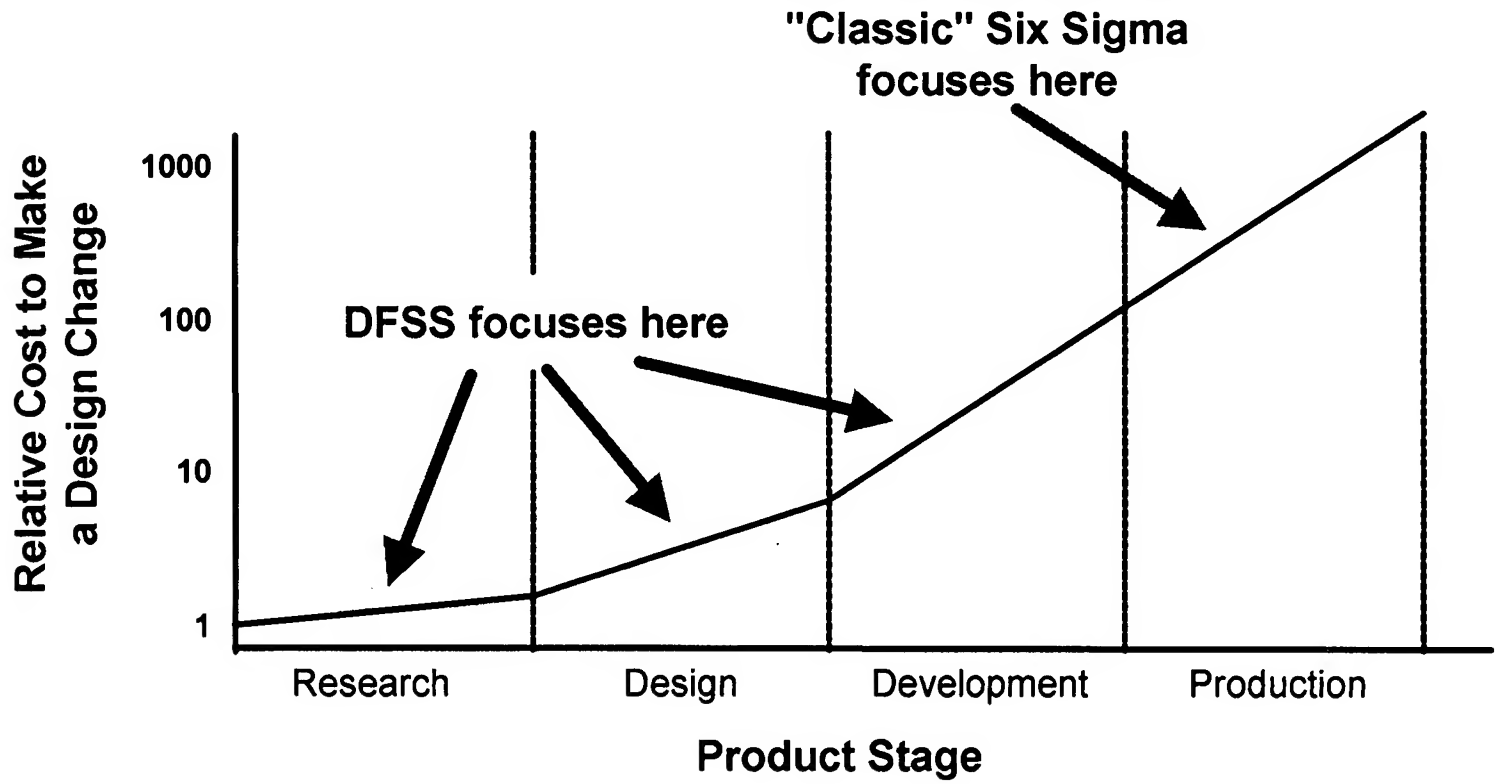
the systems and products that deliver value to our customers are perfectly designed to achieve the results we are getting today.

DFSS – What is it?

Design For Six Sigma is:

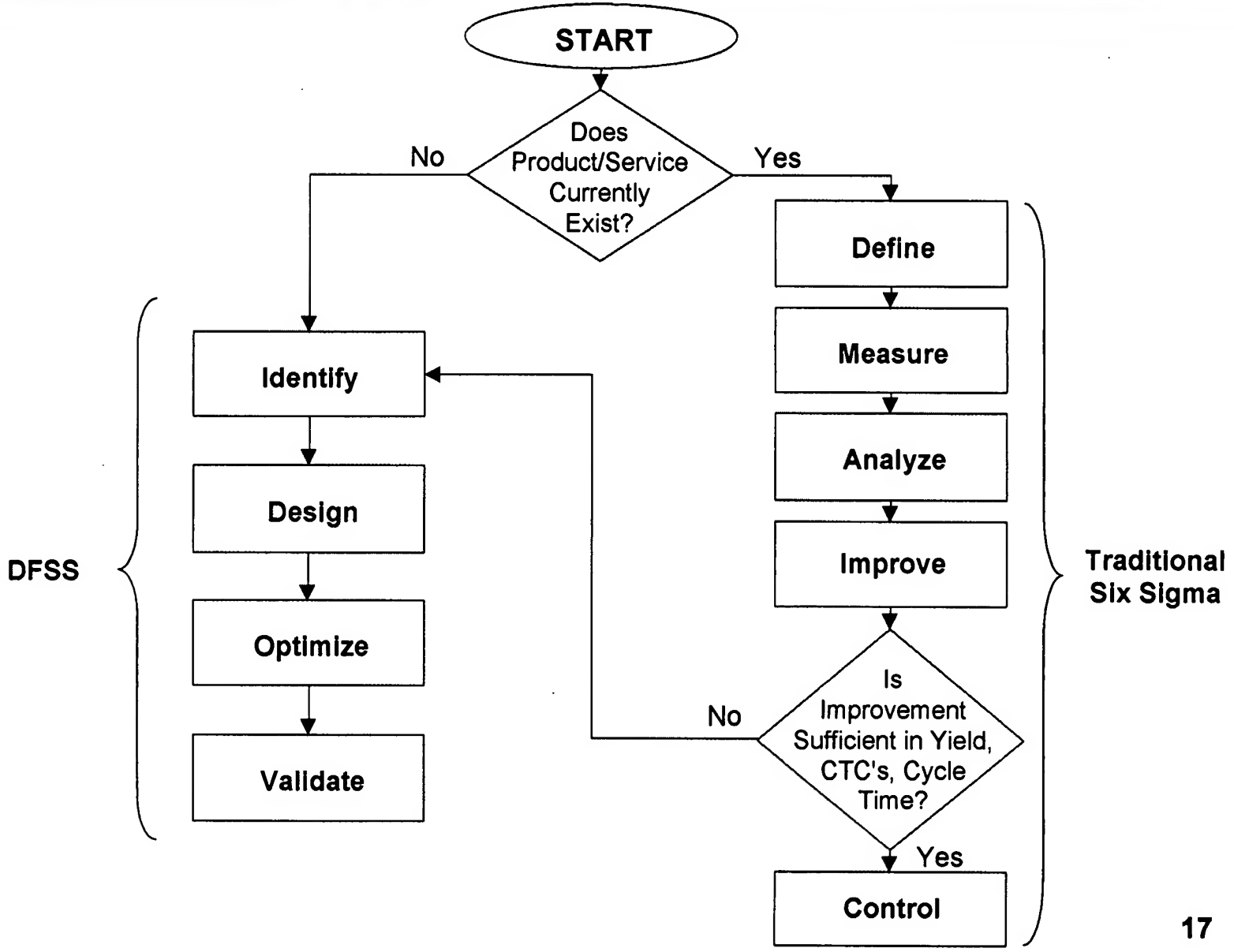
- **A methodology for designing new products and/or processes.**
- **A methodology for re-designing existing products and/or processes.**
- **A way to implement the Six Sigma methodology as early in the product or service life cycle as possible.**
- **A way to exceed customer expectations.**
- **A way to gain market share.**
- **A strategy toward extraordinary ROI.**

Why DFSS



- "Design in" quality when costs are lowest
- Show customers "Six Sigma" products right from the start

The Big Picture

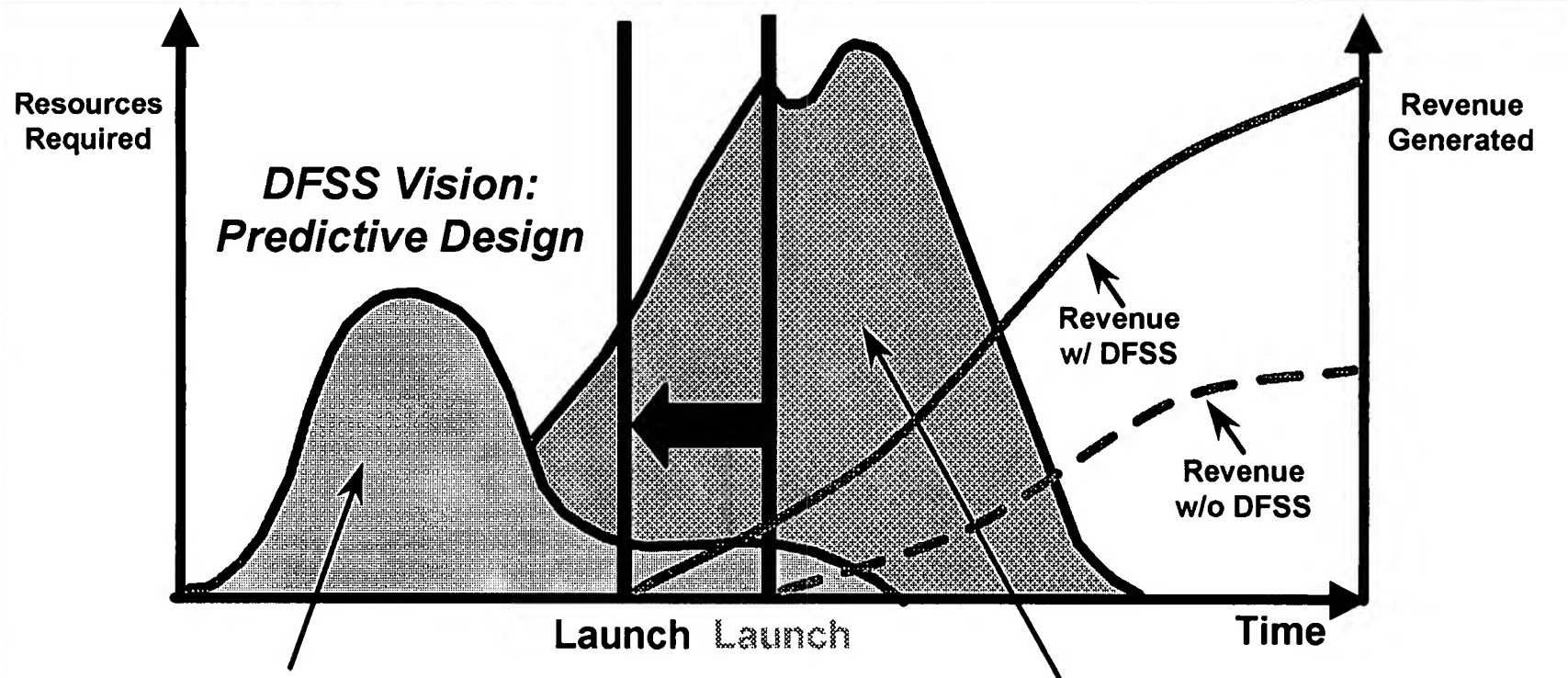


The Benefits of DFSS

- **Goal: Create new *game-changing* products and services which**
  - **Wow customers with 6σ *performance* on their CTCs**
  - **Have 6σ *reliability***
  - **Have 6σ *manufacturability***
  - **Have *high performance/cost ratios***
- **Payoffs**
  - ***Quality designed in* from the start**
  - **Revenue *growth*: customer delight, market share, volume, price**
  - **Warranty cost reductions**

Driver for growth

The Opportunity of DFSS



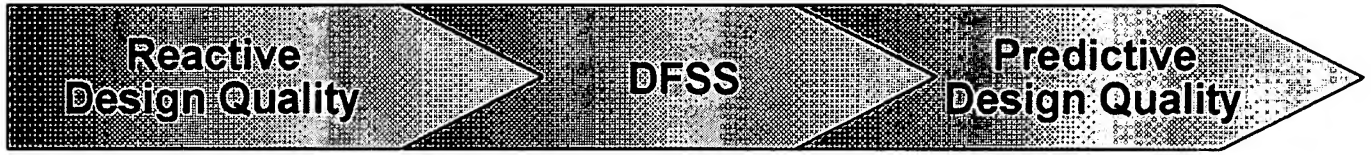
- Early problem identification; solution when costs low
- Faster market entry: earlier revenue stream, longer patent coverage
- Lower total development cost
- Robust product at market entry: delighted customers
- Resources available for next game-changer

Pre-DFSS: Reactive Design

- Unhappy customers
- Unplanned resource drain
- Skyrocketing costs
- Next product compromised

- Upfront investment is most effective and efficient
- Show customers "6s" products right from the start

The Vision of DFSS

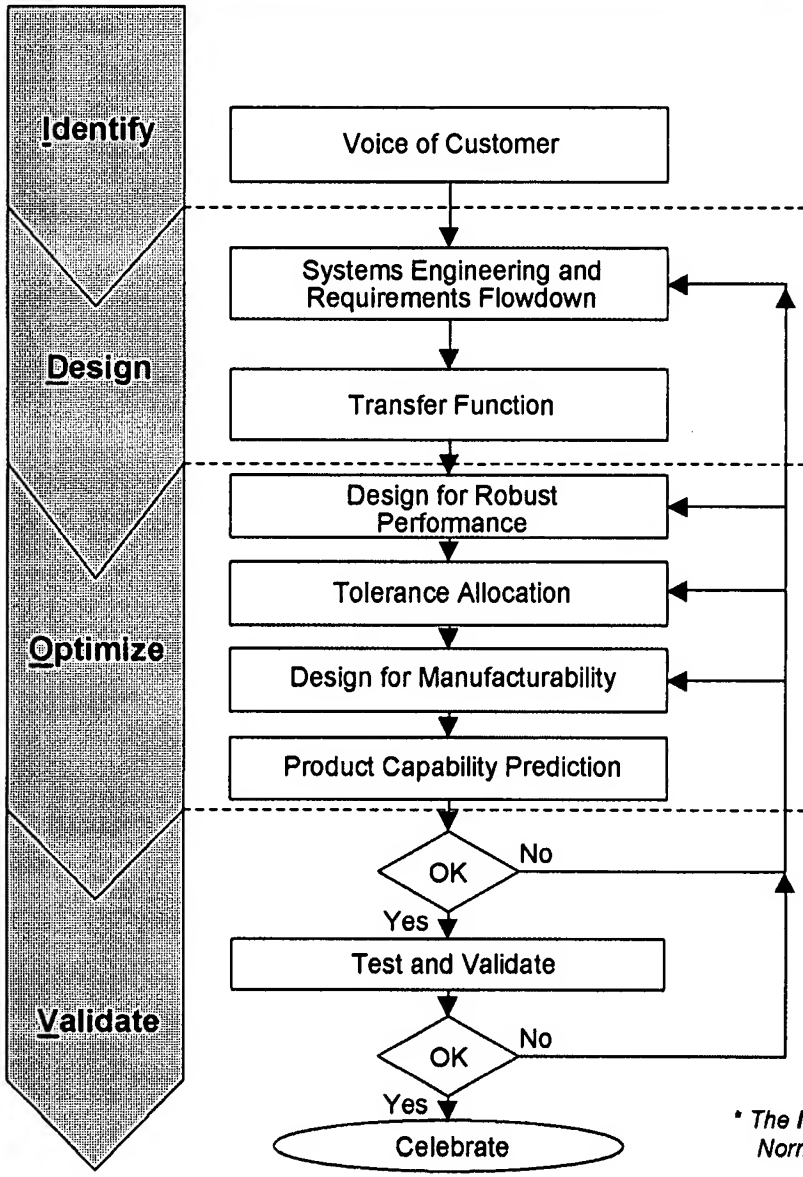


From
- Evolving design requirements
- Extensive design rework
- Product performance assessed by "build and test"
- Performance and producibility problems fixed <u>after</u> product in use
- Quality "tested in"

To
- Disciplined CTC flowdown
- Controlled design parameters
- Product performance modeled and simulated
- <u>Designed</u> for robust performance and producibility
- Quality "designed in"

- 6 s products everywhere
- Revolutionize Engineering

DFSS Process



- Strategic Plan
- Benchmark Results
- Prioritized Customer Requirements
- Prioritized CTC's
- House of Quality #1
- Initial Performance Scorecard

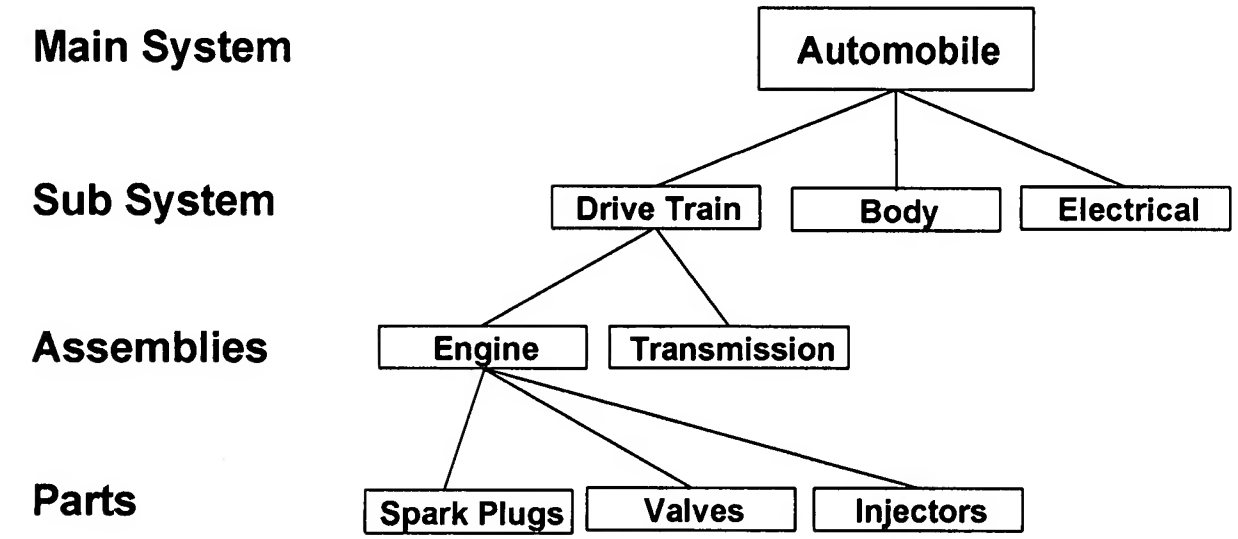
- For each CTC, Identify Design Parameters
- House of Quality #2
- Prioritized Product Design Characteristics
- Transfer Function(s)
- Preliminary Design Risk Assessment
- Performance/Process Scorecard

- Process Capability Studies
- Reliability Studies
- Capability Flowup
- Optimal Design
- Tolerances on X's
- Complete Scorecard

- Capable Product and Process
- Sensitivity Analysis
- Assess Performance, Reliability, and Risks

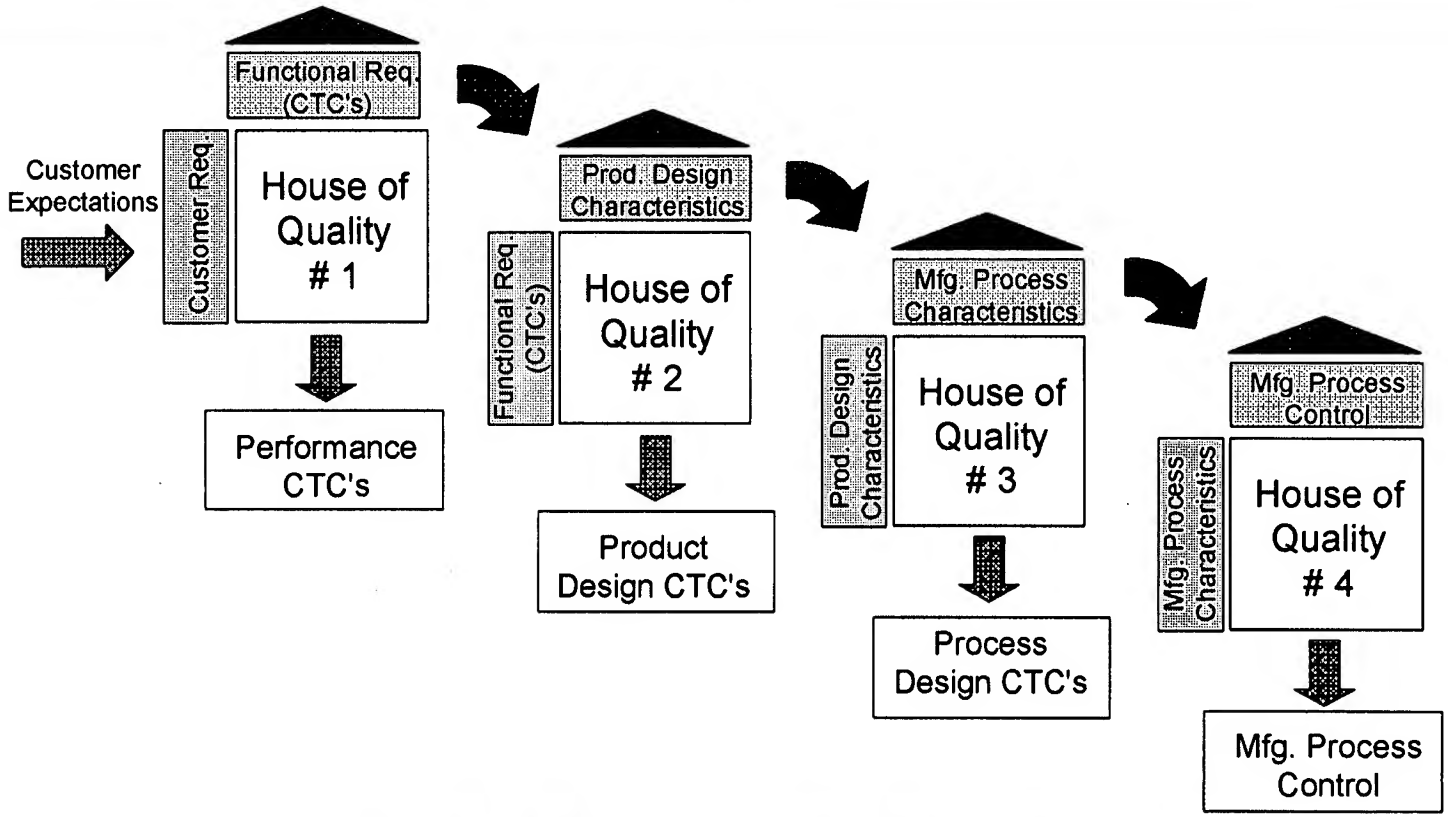
* *The **IDOV** four-phase DFSS process originated with Dr. Norm Kuchar at GE CRD and is used with permission.*

Systems Engineering



- Complex products may require the "Divide and Conquer" approach.
- Flow the system requirements down and roll the capability up.
- System Engineers are the masters of the scorecard and make tradeoff decisions.

DFSS and Six Sigma



Marketing
- Features
- Quality
- Performance
- Cost

Design Engineering
- Performance
- Reliability
- Cost

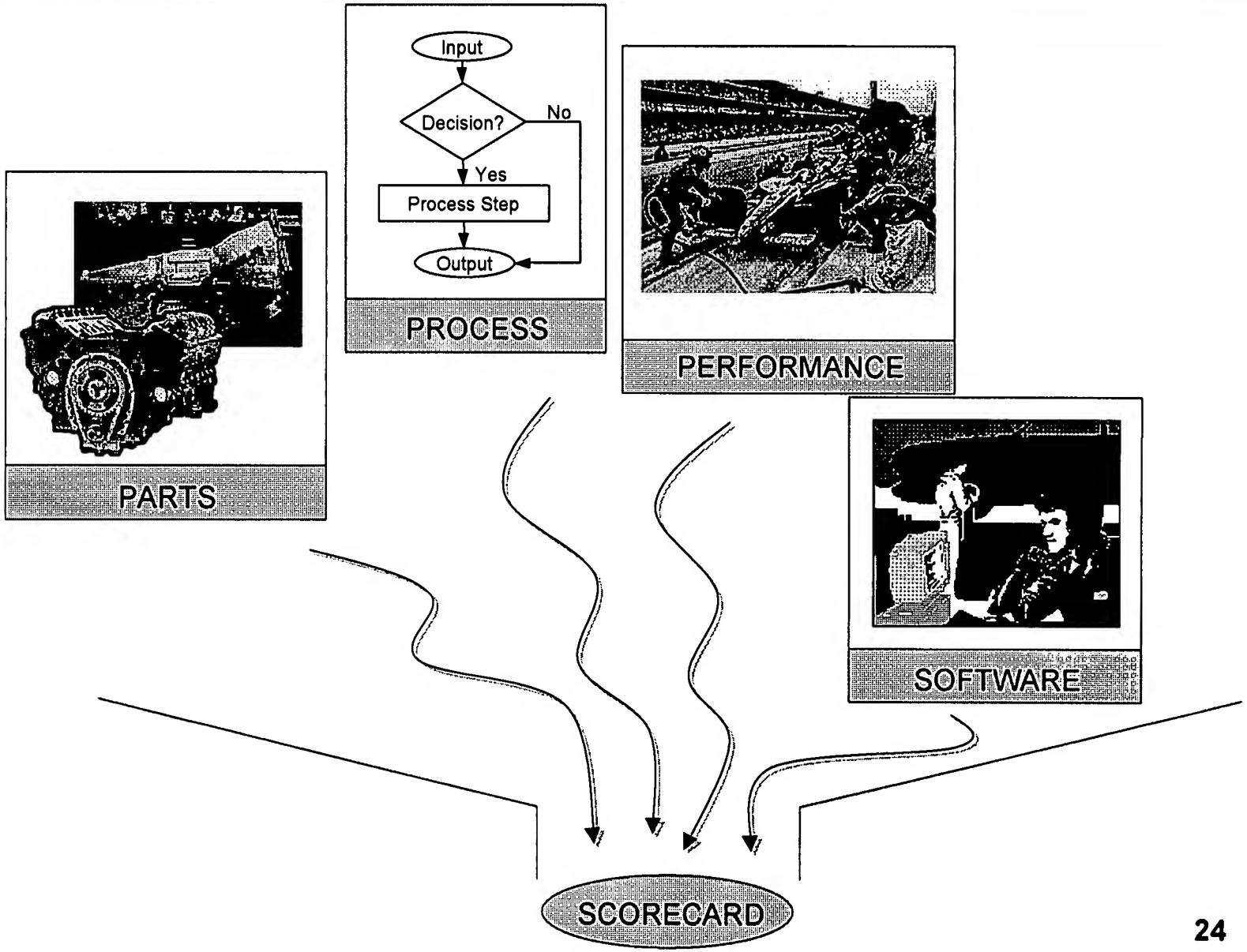
Mfg. Engineering
- Manufacturability
- Cost

Manufacturing
- SPC
- Process Capability

DFSS

Six Sigma

Scorecard Components



Scorecard Example

SOLENOID PART SCORECARD

#	Part Name	DPU	Qty	Continuous Variable						Sample Size Known		ppm Only
				Target	Mean	Std Dev	LSL	USL	UOM	Sample Size	# Defective	ppm
1	Wire	0.0000220	1									22
2	Power Supply	0.0008582	1	1.1	1.1	0.015	1.05	1.15	Amps			
3	Core (Length)	0.0000044	1	15	15	0.45	13	18	cm			
4	Core (Radius)	0.0008582	1	2	2	0.3	1	3	cm			
5												
6												
7												

SOLENOID PROCESS SCORECARD

#	Process Step	DPU	Qty	Continuous Variable						Sample Size Known		ppm Only
				Target	Mean	Std Dev	LSL	USL	UOM	Sample Size	# Defective	ppm
1	Apply Wire to Core	0.000063	1	110	110	1	108	114	Twist			
2	Attach Power Supply	0.000200	1							10000	2	
3												
4												
5												
6												

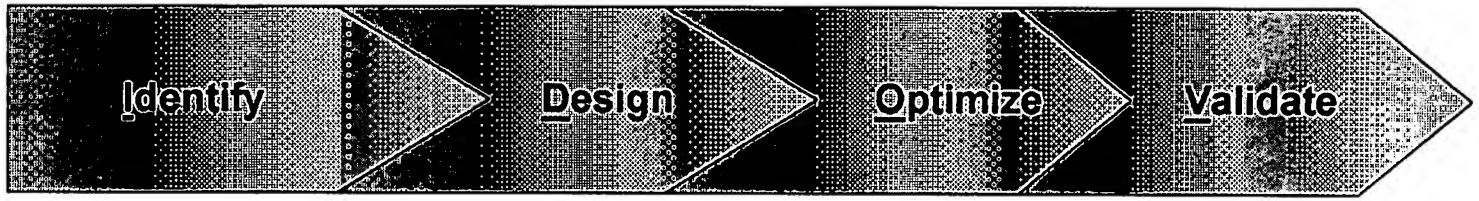
SOLENOID PERFORMANCE SCORECARD

#	Performance	DPU	Qty	Continuous Variable						Sample Size Known		ppm Only
				Target	Mean	Std Dev	LSL	USL	UOM	Sample Size	# Defective	ppm
1	Mag Force 4cm from center	0.0000921	1	7.5	7.47	0.254	6.5	8.5	Amp/cm			
2												
3												
4												

Solenoid Scorecard (cont.)

Scorecard Summary						
	# Steps/Parts	Total dpu	Yield	dpmo	ST Sigma	LT Sigma
Part	4	0.001743	99.826%	435.72	4.8289	3.3289
Process	2	0.000263	99.974%	131.69	5.1485	3.6485
Performance	1	0.000092	99.991%	92.12	5.2393	3.7393
Software						
Total	7	0.002098363	99.790%	299.766	4.932	3.432

DFSS Tools



- Project Charter
- Strategic Plan
- Cross-Functional Team
- Voice of the Customer
- Benchmarking
- KANO's Model
- Questionnaires
- Focus Groups
- Interviews
- Internet Search
- Historical Data
- Quality Function Deployment
- Pairwise Comparison
- Design of Experiments
- Specify CTC's
- Performance Scorecard
- Flow Charts
- FMEA
- Visualization

- Assign Specifications to CTC's
- Customer Interviews
- Formulate Design Concepts
- Pugh Concept Generation
- TRIZ or ASIT
- Pugh Concept Synthesis
- Controlled Convergence
- FMEA
- Fault Tree Analysis
- Brainstorming
- QFD
- Scorecard
- Transfer Function
- Design of Experiments
- Deterministic Simulators
- Confidence Intervals
- Hypothesis Testing
- MSA
- Computer Aided Design
- Computer Aided Engineering
- High Throughput Testing

- Histogram
- Distributional Analysis
- Empirical Data Distribution
- Expected Value Analysis (EVA)
- Adding Noise to EVA
- Non-Normal Output Distributions
- Design of Experiments
- Multiple Response Optimization
- Robust Design Development
  - Using S-hat Model
  - Using Interaction Plots
  - Using Contour Plots
- Parameter Design
- Tolerance Allocation
- Reducing Standard Deviations of Inputs
- Design For Manufacturability
- Mistake Proofing
- Product Capability Prediction
- Part, Process, and SW Scorecard
- Risk Assessment
- Reliability
- Multidisciplinary Design Optimization (MDO)

- Sensitivity Analysis
- Gap Analysis
- FMEA
- Fault Tree Analysis
- Control Plan
- PF/CE/CNX/SOP
- Run/Control Charts
- Mistake Proofing
- MSA
- Reaction Plan

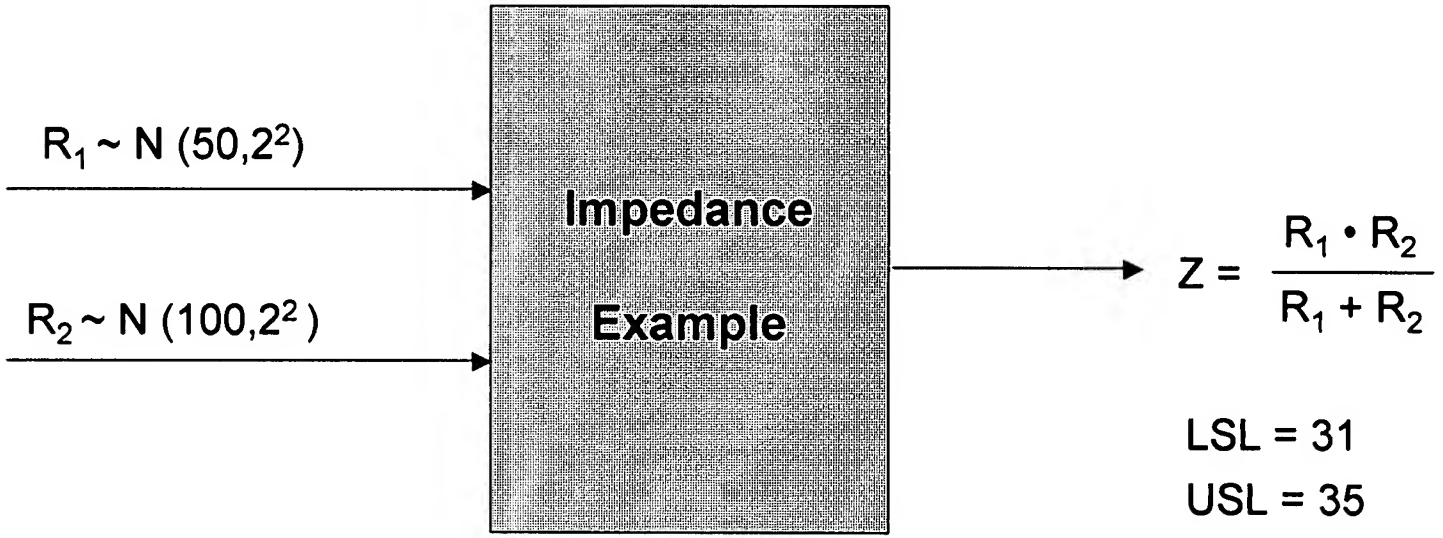
High Throughput Testing (HTT)

(for all two-way combinations)

Full Factorial = 8100 runs **HTT = 27 runs**

5 Levels **Motherboard**	*3 Levels* **Ram**	*3 Levels* **BIOS**	*3 Levels* **CD**	*5 Levels* **Monitor**	*3 Levels* **Printer**	*2 Levels* **Voltage**	*2 Levels* **Resolution**
Gateway	128 MB	Dell	Generic	Viewsonic	HP	220V	800 by 600
ASUS	256 MB	Award	Teac	Sony	Lexmark	110V	800 by 600
Micronics	512 MB	Dell	Sony	KDS	Cannon	110V	1024 by 768
Dell	128 MB	Generic	Teac	NEC	Lexmark	220V	1024 by 768
Compaq	256 MB	Generic	Sony	Generic	HP	110V	800 by 600
Dell	256 MB	Award	Generic	Viewsonic	Cannon	110V	1024 by 768
ASUS	512 MB	Award	Sony	Sony	HP	220V	1024 by 768
Micronics	128 MB	Award	Teac	Generic	Cannon	220V	800 by 600
Gateway	256 MB	Award	Teac	KDS	HP	220V	800 by 600
Compaq	512 MB	Dell	Teac	Viewsonic	Lexmark	220V	800 by 600
Gateway	128 MB	Generic	Sony	Sony	Cannon	110V	1024 by 768
Dell	256 MB	Dell	Sony	NEC	HP	110V	800 by 600
ASUS	128 MB	Generic	Generic	KDS	Lexmark	110V	800 by 600
Micronics	256 MB	Generic	Sony	Viewsonic	Lexmark	110V	800 by 600
Compaq	512 MB	Award	Generic	NEC	Cannon	110V	1024 by 768
ASUS	512 MB	Dell	Generic	Generic	Lexmark	110V	1024 by 768
Micronics	128 MB	Dell	Generic	Sony	HP	110V	800 by 600
Dell	512 MB	Generic	Teac	Sony	HP	110V	800 by 600
Gateway	512 MB	Award	Teac	NEC	Lexmark	110V	800 by 600
ASUS	128 MB	Award	Teac	Viewsonic	Cannon	110V	800 by 600
Compaq	128 MB	Award	Teac	Sony	HP	110V	800 by 600
Dell	128 MB	Award	Teac	KDS	HP	110V	800 by 600
ASUS	128 MB	Award	Teac	NEC	HP	110V	800 by 600
Dell	128 MB	Award	Teac	Generic	HP	110V	800 by 600
Micronics	128 MB	Award	Teac	NEC	HP	110V	800 by 600
Compaq	128 MB	Award	Teac	KDS	HP	110V	800 by 600
Gateway	128 MB	Award	Teac	Generic	HP	110V	800 by 600

Tolerance Allocation Example



If we were able to change a resistor's standard deviation, which resistor, R_1 or R_2, would have the greater impact on the dpm of Z (impedance)?

Tolerance Allocation Example (cont.)

A reduction of R_1 by 50% reduces dpm by an order of magnitude X, while R_2 has little impact.

Tolerance Allocation Table N = 10,000 (in defects per million)		
Impedance Table		
	R1	R2
-50% Sigma	372.40	34,683
-25% Sigma	8,058	36,849
-10% Sigma	23,906	35,663
Nominal	39,220	39,657
+10% Sigma	59,508	37,556
+25% Sigma	92,398	47,317
+50% Sigma	148,113	46,801

A reduction of R_1's standard deviation by 50% combined with an increase in R_2's standard deviation by 50%

$$R_1 \sim N(50, 1^2)$$

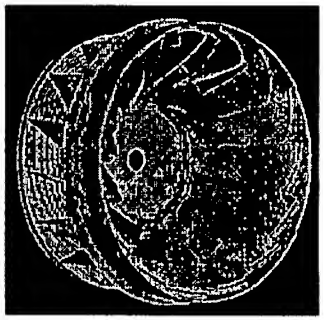
$$R_2 \sim N(100, 3^2)$$

results in a dpm = 1,254.

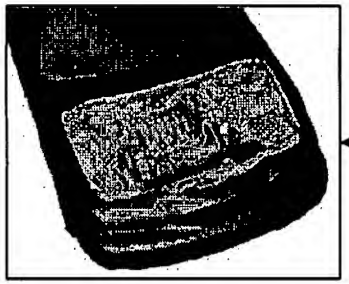
Examples of Simulation and High Performance Computing (HPC)

Power

Simulation of stress and vibrations of turbine assembly for use in nuclear power generation →



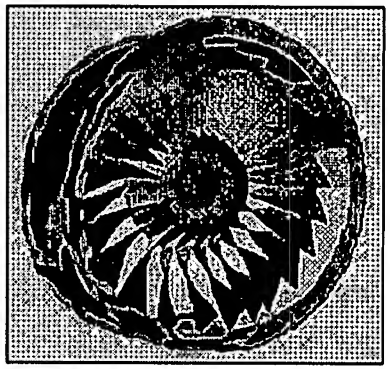
Automotive



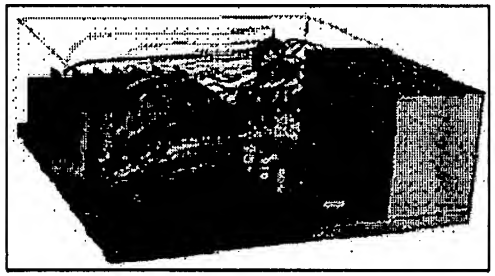
← Simulation of underhood thermal cooling for decrease in engine space and increase in cabin space and comfort

Aerospace

Evaluation of dual bird-strike on aircraft engine nacelle for turbine blade containment studies →



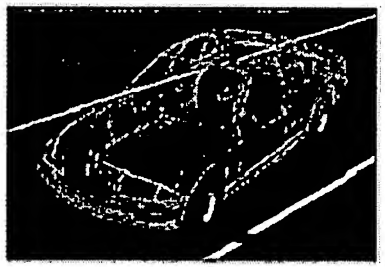
Electronics



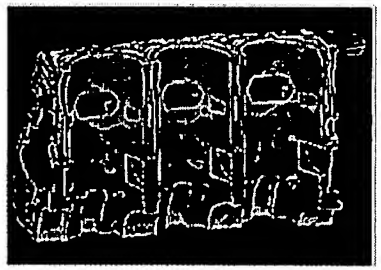
← Evaluation of cooling air flow behavior inside a computer system chassis

Examples of Computer Aided Engineering (CAE) and Simulation Software

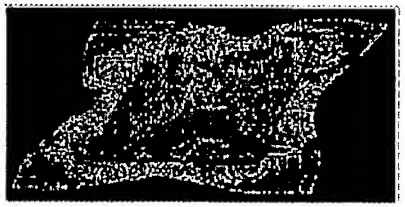
Mechanical motion: Multibody kinetics and dynamics
- ADAMS®
- DADS



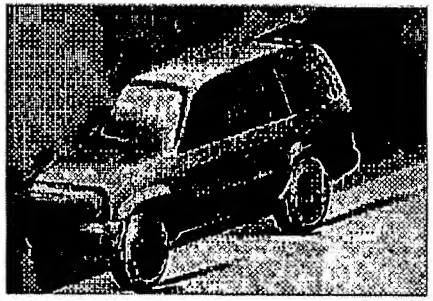
Implicit Finite Element Analysis: Linear and nonlinear statics, dynamic response
- MSC.Nastran™, MSC.Marc™
- ANSYS®
- Pro MECHANICA
- ABAQUS® Standard and Explicit
- ADINA



Explicit Finite Element Analysis : Impact simulation, metal forming
- LS-DYNA
- RADIOSS
- PAM-CRASH®, PAM-STAMP



General Computational Fluid Dynamics: Internal and external flow simulation
- STAR-CD
- CFX-4, CFX-5
- FLUENT®, FIDAP™
- PowerFLOW®

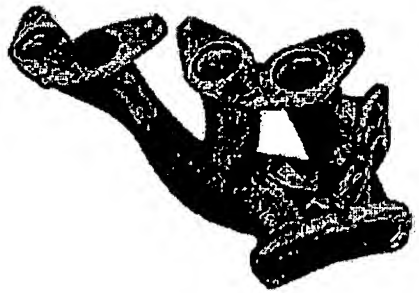


Air Academy Associates

Examples of Computer Aided Engineering (CAE) and Simulation Software (cont.)

Preprocessing: Finite Element Analysis and Computational Fluid Dynamics mesh generation

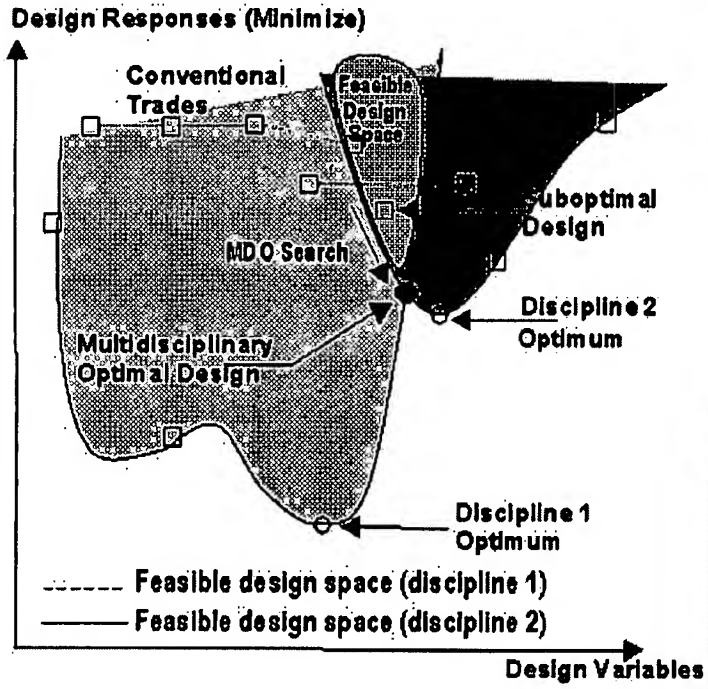
- ICEM-CFD
- Gridgen
- Altair® HyperMesh®
- I-deas®
- MSC.Patran
- TrueGrid®
- GridPro
- FEMB
- ANSA

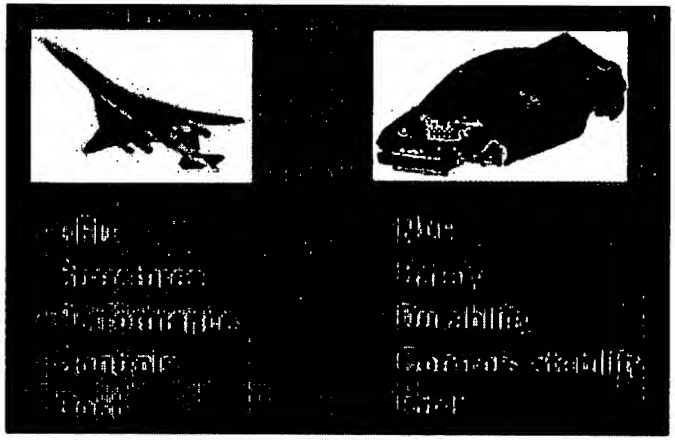


Postprocessing: Finite Element Analysis and Computational Fluid Dynamics results visualization

- Altair® HyperMesh®
- I-deas
- MSC.Patran
- FEMB
- EnSight
- FIELDVIEW
- ICEM CFD Visual3 2.0 (PVS)
- COVISE

Multidisciplinary Design Optimization (MDO): A Design Process Application



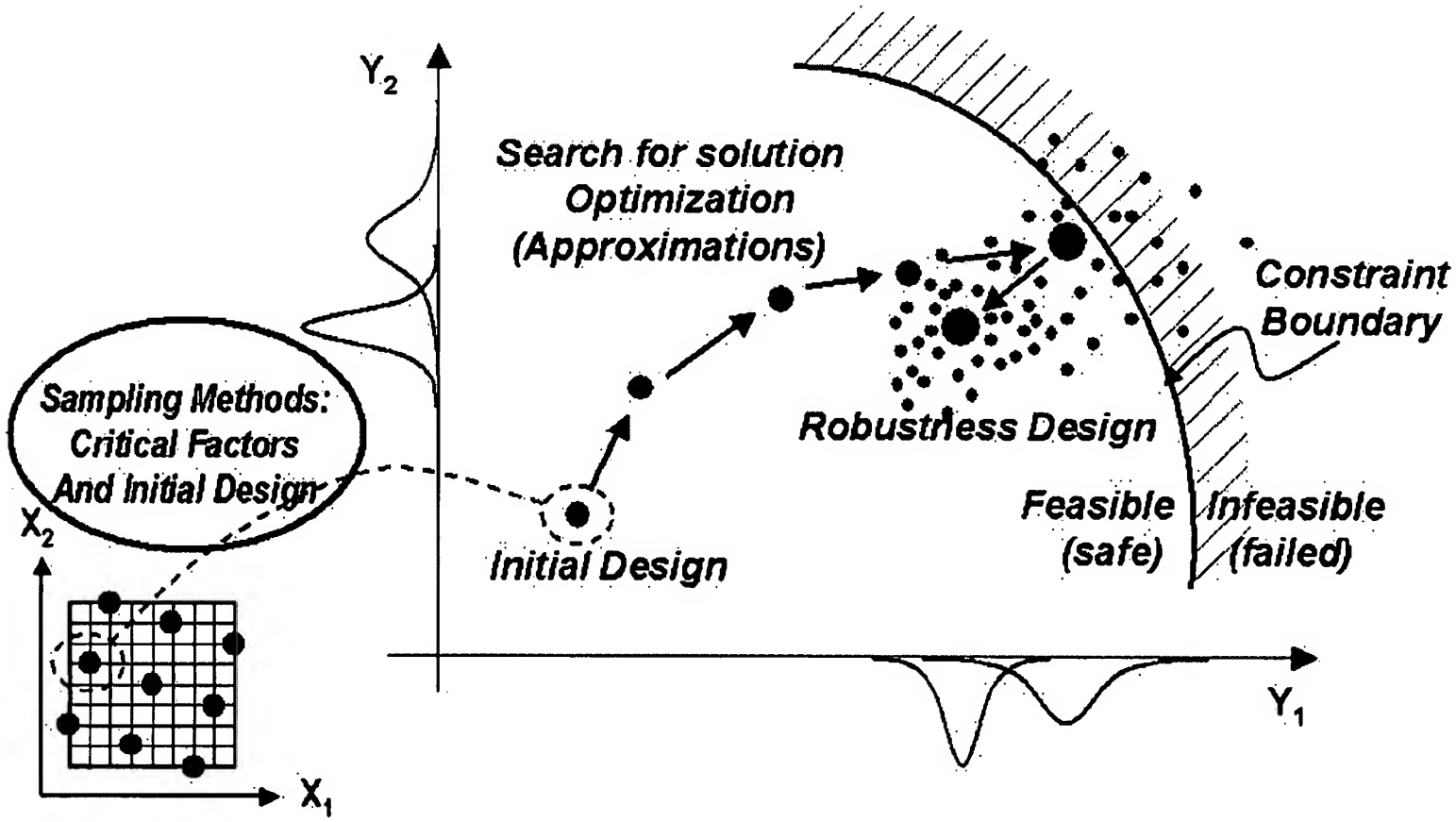


Key Elements of MDO

- Massive Computational Problem;
- Solution by decomposition effective for complex systems;
- Multiprocessor computing simplifies MDO solutions conceptually & enables solutions previously intractable;
- Aids in the management of the design process.

Mastery of interactions between the disciplines (or, subsystems) is as important as the methods & tools used within a single discipline

MDO: A Design Improvement Process



Environments Where MDO/HPC Is Beneficial

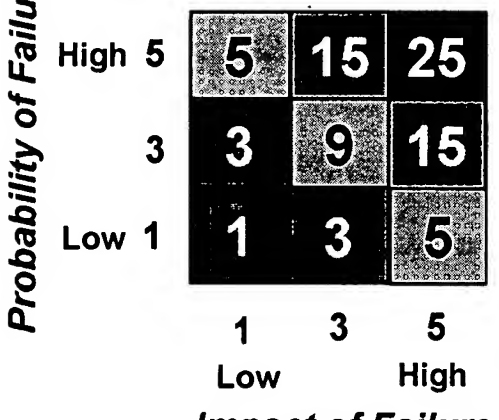
Design of complex vehicles & systems results in a simulation environment with:

- A high number of design variables
- A substantial number of design subsystems and engineering disciplines
- Interdependency and interaction between the subsystems
- High resolution, complex models across several engineering disciplines

Risk Assessment

- Assess risks of key areas: technology, cost, schedule, market, etc.
- Use formal tools: FMEA, etc.
- Quantify risks: probability of failure and impact of failure
- Formulate responsive projects to reduce high risks
- Track progress with quantitative risk "waterfall"

Quantifying Risk



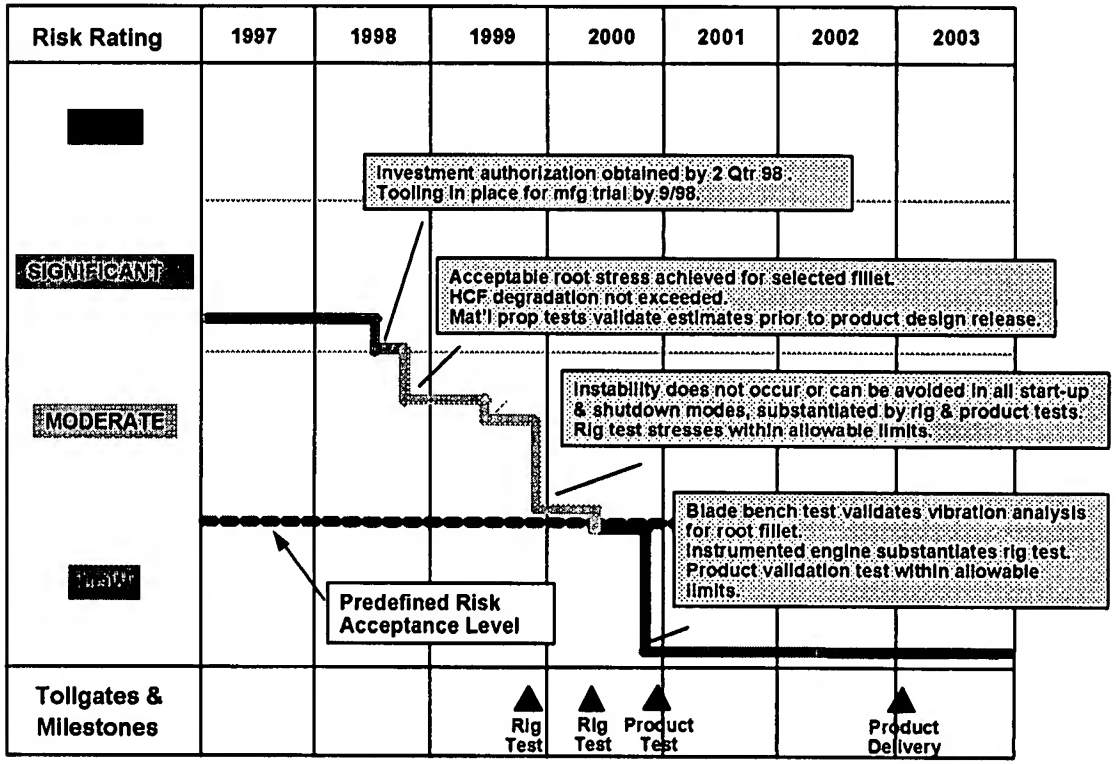
R Show stopper

O Significant risk

Y Fix before production

G Proceed with caution

Tracking Risk



Characteristics of a Successful DFSS Implementation

- Commitment and leadership from the top
- Measurable, "stretch" goals for each project
- Accountability for project success
- Involvement and support of *everyone*
- Training and implementing an extremely powerful, yet easy-to-use toolset for predicting quality and making tradeoffs before the product or process is even built

- It's very easy to focus on the last item...
- But, the first four – involving *leadership* and *cultural change* – are even more critical for success